Technology Innovation Project *Project Brief*

TIP 292: Advanced Heat Pump Water Heater Research

Context

The 6th Power Plan calls for a 50% penetration of heat pump water heaters in the Pacific Northwest Region (PNWR) by 2030. According to the recently released Residential Building Stock Assessment, 55% of the region's residences have electric water heaters, of which only 0.02% are heat pumps. Concerns expressed about this technology include: the sufficiency of hot water supply; the demand response potential; and performance of the technology in colder climates. Some utilities have expressed concerns about homeowner comfort when installations are inside the conditioned space and are reluctant to support the current market integrated systems. They are especially interested in split systems which do not remove heat from conditioned space; however they want to see how the technology works in their climate.

Description

Washington State University Energy Program (WSUEP), in partnership with Avista, Energy Trust of Oregon, Northwest Energy Efficiency Alliance (NEEA), Ravalli Electric Co-op and Tacoma Public Utilities, will research and demonstrate the capabilities of high-performance, next-generation heat pump water heaters in the laboratory and in the field.

The project brings a split system, carbon dioxide (CO2) heat pump water heater with a dedicated, variable-speed outdoor compressor, to the Pacific Northwest, where it will be subjected to the same lab and field tests as the integrated heat pump water heaters already marketed in the region. The research will take place over three years. In the first year the equipment will be imported and lab tested. In the second and third years it will be field tested in all three of the region's heating zones.

The equipment under study solves the issue of increasing the space-heating load of residences served by integrated heat pump water heaters. This CO2 refrigerant technology promises to provide cost-effective high performance over a wide range of temperatures, representing a significant increase in heat pump water heater performance over existing technology.

The specific tasks involved in this project include:

1. Select and import four split system CO2 heat pump water heaters.
2. Conduct lab tests to national and regional protocols.
3. Analyze lab data and report
4. Select field sites, obtain permits or waivers, and execute homeowner agreements.
5. Install HPWHs and monitoring equipment
6. Conduct field tests to regional protocols
7. Analyze field data and report

Why It Matters

It is crucial to not delay the introduction of what may be an important technology for heat pump water heaters. The PNWR stands at a crossroads. It is currently heavily invested in integrated heat pump water heater technology with single speed compressors, limited to a rated Coefficient of Performance (COP) of 2 to 2.5. WSUEP proposes to introduce a variable speed split system with a COP rated greater than 3 in normal conditions, and a COP of 2 in temperatures as low as 17° F. The probability of success is high with the partnership that has come together for this project.

Assuming an average annual hot water load of 3,300 kWh and an average annual COP of 3, the annual savings would be approximately 2,200 kWh per residence. This system does not add to the space heat load of the home to which it supplies hot water.

Goals and Objectives

This is a low-cost research project with potentially significant ramifications. It will bring a CO2 split system dedicated heat pump water heater to the Pacific Northwest and subject it to all the tests that current integrated systems have undergone. This will allow necessary comparisons to be made.

WSUEP's long-term strategy is to find a supplier for this project who is also interested in developing a cost-effective carbon dioxide refrigerant heat pump water heater. This was part of the qualifications explored when WSUEP and its Project Advisory Task Force chose a manufacturer. The results of this project will directly influence the design of a split system CO2 HPWH for introduction into the US market.

Additional technology transfer will include presentations at major regional and technical conferences; introduction of energy efficiency measures to the Regional Technical Forum; advocacy to regional utilities; and coordination with national groups such as CEE and EPRI.

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Project Start Date: December 7, 2012

Project End Date: September 30, 2015

Reports & References (Optional)

Links (Optional)

Funding

Total Project Cost:	$720,000
BPA Share:	$360,000
External Share:	$360,000
BPA FY2015 Budget:	$160,000

For More Information Contact:

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Participating Organizations

Washington State University Energy Program
Avista Corporation
The Energy Trust of Oregon
Northwest Energy Efficiency Alliance
Ravalli Electric Co-op
Tacoma Public Utilities